east are comparable with those occupying the interior of the plateaus. The descent of the canyon of the Colorado alone cannot be taken, but that of the reaches of the canyon and of the valley to where it emerges on the highlands of the Great Basin at an elevation of 7000 or 8000 feet. The descents of these valleys are not appreciated by their mean slopes, which in part are insignificant but in other places they are precipitous. It is necessary to analyze the details. Thus the writer has observed the descents of the existing land valleys through thousands of feet with characters and slopes comparable with those sunken across the sunken coast plains. This study will be brought out in detail.

Mr. Kümmel gives prominence to the hypothesis of the extraordinary sinking of the floor of the Mexican Gulf, etc., thereby accounting for the greater portion of the subsidence of the valleys. It is gratifying that the reviewer accepts the evidence of the changes of level to the same proportion as the author, although suggesting a somewhat different character. The question of determining the amount of local deformation of the continent as different from the general movement is doubtless one of the difficult points; but the author allowed any amount up to 4000 feet for covering the abyssmal subsidence in excess of the general movement south of the Mississippi. Whether too much or too little cannot yet be said. But amongst the Bahamas there is a better yard-stick. The drowned valleys reach to a depth of 12,000 or 14,000 feet, amongst islands, banks, and in the edges of the continental plateau, which last is submerged to no more than 4000 feet. Thus we cannot deduct for exaggerated marginal depression more than this amount in some places, and in others not even so much. However, the writer hopes to remove a few of the obscurities in the continental history, and thanks the reviewer for pointing out some of the greatest needs in elucidating the investigations of the great changes of level of land and sea, much new data being already at hand.

J. W. SPENCER.

Ueber Archaeische Ergussgesteine aus Småland. Von OTTO NORDENSKJÖLD. (Bull. of the Geol. Instit. of Upsala, Vol. I., No. 2, 1893, pp. 125.)

Of all rock names probably the most indefinite, and at times the most convenient, are the names: *greenstone* in America, *petrosilex* in France, *felsite* in England, and *hälleflinta* in Sweden. Many, and

often diverse types, have been grouped together by this means, and confusion has often resulted.

This paper of Dr. Nordenskjöld's forms a very important contribution to our knowledge of the Archæan rocks, and it adds new meaning to these abused terms. The Scandinavian peninsula has long been classic ground for Archæan studies, and nowhere is that formation better represented, or its problems more varied. Småland is a Baltic province comprising three districts of southern Sweden, and it is about twenty-five miles distant from Christiania. The surface occupied by the rocks described is over 10,000 square kilometers. In this paper the hälleflinta and porphyries are particularly described, and references are made to the preceding work of Eichstadt and Holst on the basalts, gabbros and other basic rocks. The term *hälleflinta* is a very old one, and designated a gneissoid, opaque rock which accompanied the ores. It was afterward applied to all rocks with a compact structure. A complete summary of the literature on this subject is given, and the progress in the knowledge of the true nature of such rocks is also pointed out. They were long regarded as of sedimentary origin. In 1877, Allport, in England, proved the Shropshire greenstones to be acid eruptives, and he was soon supported by the other English petrographers. Rocks similar to the Småland types were described by Irving in the copper-bearing series, by Williams in the South Mountain district, and by Sederholm in Finland.

The study of the Smaland rocks was commenced by Nordenskjöld in 1889, and their eruptive origin first shown in 1892. In this area occur four belts of the *hälleflinta*, each 60 to 100 kilometers long and 10 to 15 kilometers wide. They contain neither glass nor microfelsite, and so cannot be classed as felsophyres or vitrophyres; further, they are identical with the South Mountain rhyolites. The granites of the area are both coarse and fine grained; the latter, or aplitic variety, grades into the *hälleflinta*, and it often contains dark basic patches. The porphyries occupy a position between the granites and the eovolcanics, but they are allied to both. The granophyres are closely connected with the Lönneberg eodacite, especially near Näshult, where the rock is rich in augite. Porphyritic dyke rocks occur in many places, but always in or near the hälleflint areas. They are identical with the massive porphyries, and they represent the last stage of the eruption. They occur by the hundred close together and parallel, but always separate.

The rocks so far described show but little variation, and they are mainly important in their transition to the next series of eovolcanics which cover nearly one-half of the area. The acid eruptives include the eorhyolites and eodacites which chemically are almost identicaf with the younger rhyolites and dacites. They possess a porphyritic structure and a black felsitic groundmass. All the rocks described in the paper show strong mechanical deformations, but chemical alteration of the minerals in this series is so rare that it is probable they were broken during their eruption. The structure is almost cryptocrystalline, and it varies even in the same thin section. A considerable number of accessory minerals occur and pseudomorphs are quite common. Epidote is present, as in the South Mountain rocks. In the eorhyolites eutaxitic structure is less common than in the other types. The groundmass is weakly doubly refracting and red in color due to hematite flakes. Among the pyroclastic rocks occur the volcanic equivalents of the porphyries. Quartz is rarely present, yet the rocks are more acid than the eodacites. Under the primary breccias are included the eutaxites and the agglomerate lavas, the former showing flow structure, the latter being fragmental. The agglomerates possess the rhyolitic structure of Rutley or the aschen structure of Mügge, which argues for a tuff-like origin. The absence of foliation and transition into the eutaxites speaks against this view, thus leaving the question open. Near Kolsjön occur fine examples of perlitic partings, spherulites and lithophysæ. The chemical work of Santesson shows no essential difference from the younger eruptives. The presence of manganese allies these rocks to the South Mountain types, and the high alkali percentage joins them with the keratophyres and dacites.

In age the rocks are pre-Cambrian. Sederholm divides the Archæan into three divisions: Katarchæan, Bottnian, Karelian (Algonkian). The Småland granites and hälleflinta are katarchæan and belong to the group of oldest known volcanics. There are no safe mineralogical distinctions between the eovolcanic and the younger porphyries, but there is a difference of habit. In the older rocks there is a greater occurrence of crypto-crystalline structure and less of the granophyric or microfelsitic arrangement. The boundaries of the mineral constituents are indistinct, and there is a greater number of secondary constituents. Spherulites and other characters also enter. The eruptive character of the rocks is proved by :

1. Absence of true stratification.

2. Order of crystallization.
3. Flow structure.
4. Implication structures (micro, and crypto-pegmatite).
5. Spherulitic structure.
6. Spheroidal (kugel) structure.
7. Perlitic partings.

The original appearance of these rocks cannot be described, for they have been completely altered by dynamo metamorphism and its attendant changes, among which devitrification has been most active.

Throughout the paper the prefix *eo*, as in eorhyolite, is used to show the relation of the old volcanic to the newer type with which it is closely connected. This brings in the troublesome age question in classification. At present there is a reaction against the use of age terms in petrography, and it would be better to employ the prefix *apo*, as suggested at nearly the same time by Miss Bascom,[1] and thus avoid the old discussions and objections. Dr. Nordenskjöld refers to this prefix in a note at the end of his paper, and signifies his willingness to adopt the *apo* prefix if it is regarded by petrographers as a better one.

G. PERRY GRIMSLEY.

[Several reviews intended for this number are deferred to give place to standard articles.]

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[1] JOURNAL OF GEOLOGY, Vol. I., p. 813, 1893.